NATURAL RESOURCES

An important aspect of the City's quality of life is its natural environment. Natural beauty contributes to the attractiveness of Lexington and the surrounding area. Local soils, vegetation and other natural features are essential components of our community. Although almost fully developed, the City retains a network of streams and woodlands. Most of the neighborhoods of the City are also blessed with large numbers of mature trees. Several creeks flow through the City and the Maury River comprises the northern City limits. Views of the surrounding mountains are visible from much of the City.

This chapter will describe and evaluate the various features making up the local natural environment, indicate the mechanisms by which the City is ensuring their protection and make recommendations for additional steps which might be taken to better protect its natural resources.

GOAL: Maintain the quality of life by preserving the natural environment and protecting against environmental hazards.

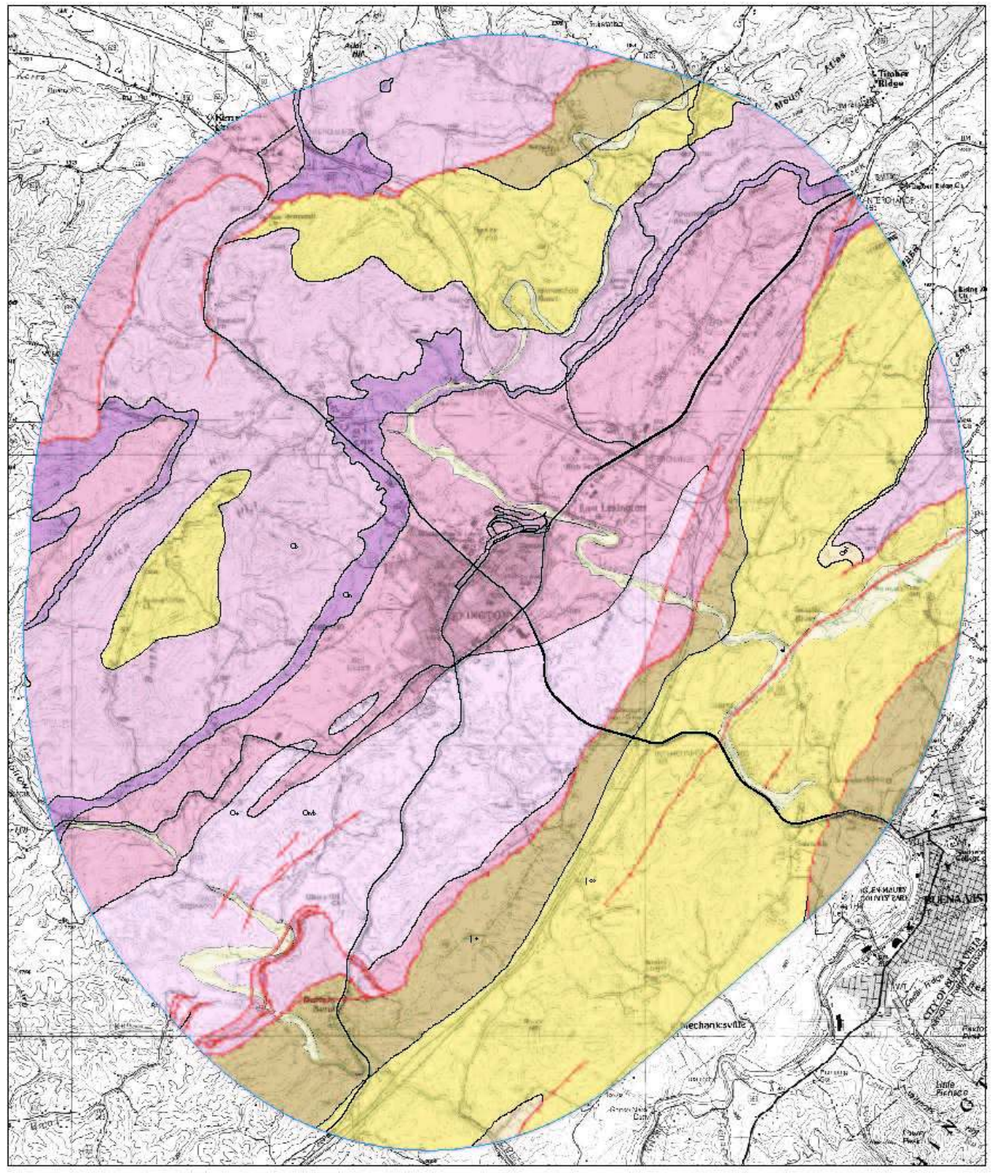
GOAL: Continue to work to be a good steward of our natural resources and a good neighbor to other communities whose environment, including their watersheds, air quality, and view sheds, may be impacted by our activities.

PHYSIOGRAPHY

The physiography of an area is a description of its geology and other related natural phenomena. Each physiographic province or natural physical subdivision is controlled essentially by its structural geology and has a unique land form which is different from other physiographic provinces. Geologists recognize five different physiographic provinces in Virginia.

Lexington lies in the Great Valley which is part of the Valley and Ridge Physiographic Province. This province is bounded on the west by the Appalachian Plateau, which includes the Appalachian Mountains, and on the east by the Blue Ridge Province. Here, sharp ridges of resistant sandstone alternate with broad valleys underlain by easily eroded limestone, dolomite and shale. Both ridges and valleys are the product of intense folding of ancient sea sediments which occurred during the formation of the Appalachians some 250 to 300 million years ago and the erosion which has occurred in the millenniums since. The forces that folded and buckled the ancient Appalachian ranges also graced the Great Valley with a diverse topography. Ridges of various heights and orientations dissect it, creating hundreds of valleys, each with its own waterway to drain it. The range of elevations and moisture conditions in the valley gives rise to a host of different vegetation types which, in turn, leads to a great variety of wildlife habitats. A map of the geology of the area is presented as Figure 3.1.

FIGURE 3.1
MAP OF AREA GEOLOGY



GEOLOGY AND MINERAL RESOURCES IN A 5-MILE RADIUS OF LEXINGTON

al — **ALLUVIUM**
Unconsolidated clay, sand and gravel.

Omb — **MARTINSBURG FORMATION**
Upper: Sandstone, siltstone, and shale, light- to medium-gray; distinctive Cruziana ichnofacies zone near top of unit. Sandstone, fine-grained, thin-bedded; Lower: limestone, argillaceous, light-gray, very thick- to thin-bedded. Up to 1500 feet thick.

Oe — **EDINBURG FORMATION**
Collierstown limestone: limestone, coarse-grained, fossiliferous; Liberty Hall facies: limestone, black to dark-gray, aphanitic, interbedded with thin black shale; Lantz Mill facies: limestone, black, thick-bedded, medium- to coarse-grained, nodular weathering; Bolar Dart Member: limestone, reddish-weathering, massive, fossiliferous. 500 to 1250 feet thick.

Oln — **LINCOLNSHIRE FORMATION AND NEW MARKET LIMESTONE**
Lincolnshire Formation: limestone, dark-gray, fine- to coarse-grained, with bedded black chert; Murat facies: limestone, light-gray, coarse-grained, fossiliferous, very thick-bedded; New Market Limestone: limestone, aphanitic, light-gray, very thick- to medium-bedded. 100 to 435 feet thick.

Ob — **BEEKMANTOWN FORMATION**
Dolostone, light- to medium-gray, very thick- to medium-bedded, fine-grained, distinctive butcher-block jointing on weathered surfaces, black bedded chert, beds of white massive chert near top of unit, with some interbeds of limestone, light-to medium-gray. This unit has Knoxaxmillie west of the Staunton Fault. 1500 to 2000 feet thick.

Ost — **STONEHEDGE FORMATION**
Limestone, dark-gray to black, fine-grained, with black chert along bedding. 300 to 500 feet thick.

Oco — **CONOCOCHEAGUE FORMATION**
Limestone, medium-gray, thin- to very thick-bedded, fine-grained, with lesser amounts of light-gray, fine- to medium-grained dolostone, and calcareously cemented, fine-to medium-grained sandstone. Silty laminae stand out in relief on weathered surfaces. 2000 to 2500 feet thick.

Oe — **ELBROOK FORMATION**
Dolostone and limestone, thin-bedded, fine- to medium-grained with pink and green shale. 1325 to 2300 feet thick.

Cwbs — **WAYNESBORO AND SHADY FORMATIONS UNDIVIDED**
WAYNESBORO FORMATION Shale, maroon, green, and gray, interbedded with limestone, fine-grained, medium-gray; minor black chert nodules, and dolostone, light- to dark-gray, fine- to coarse-grained, calcareous. Approximately 1200 feet thick.
SHADY FORMATION Dolostone, dark-gray, very thick-bedded, impure, white-weathering with minor limestone beds. 1000 to 1500 feet thick.

Contact, exact
Contact, approximate
Contact, covered
Fault, exact
Fault, approximate
Fault, covered
5miClip_VDOTPrimary

Data Sources

Geology: Unpublished Rockbridge County 1:50,000-scale Geologic Map. Geology by Edgar Spencer and Gerald P. Wilkes. Virginia Division of Mineral Resources, in progress.

1

Disclaimer
This dataset is provided as is. Variable conditions arising from physical sources used to develop the data may be reflected in the data. It is designed for use at the designated scale and should not be enlarged or used for making site-specific decisions. Users must be aware of possible errors in scale, resolution, rectification, positional accuracy, development methodology, and other circumstances specific to this dataset when using information contained herein. Distribution of this map is intended for information purposes and should not be considered authoritative for navigational, engineering, legal or other site-specific uses.

0 1 2 Miles

Commonwealth of Virginia
Department of Mines, Minerals and Energy
Division of Mineral Resources
June 2007

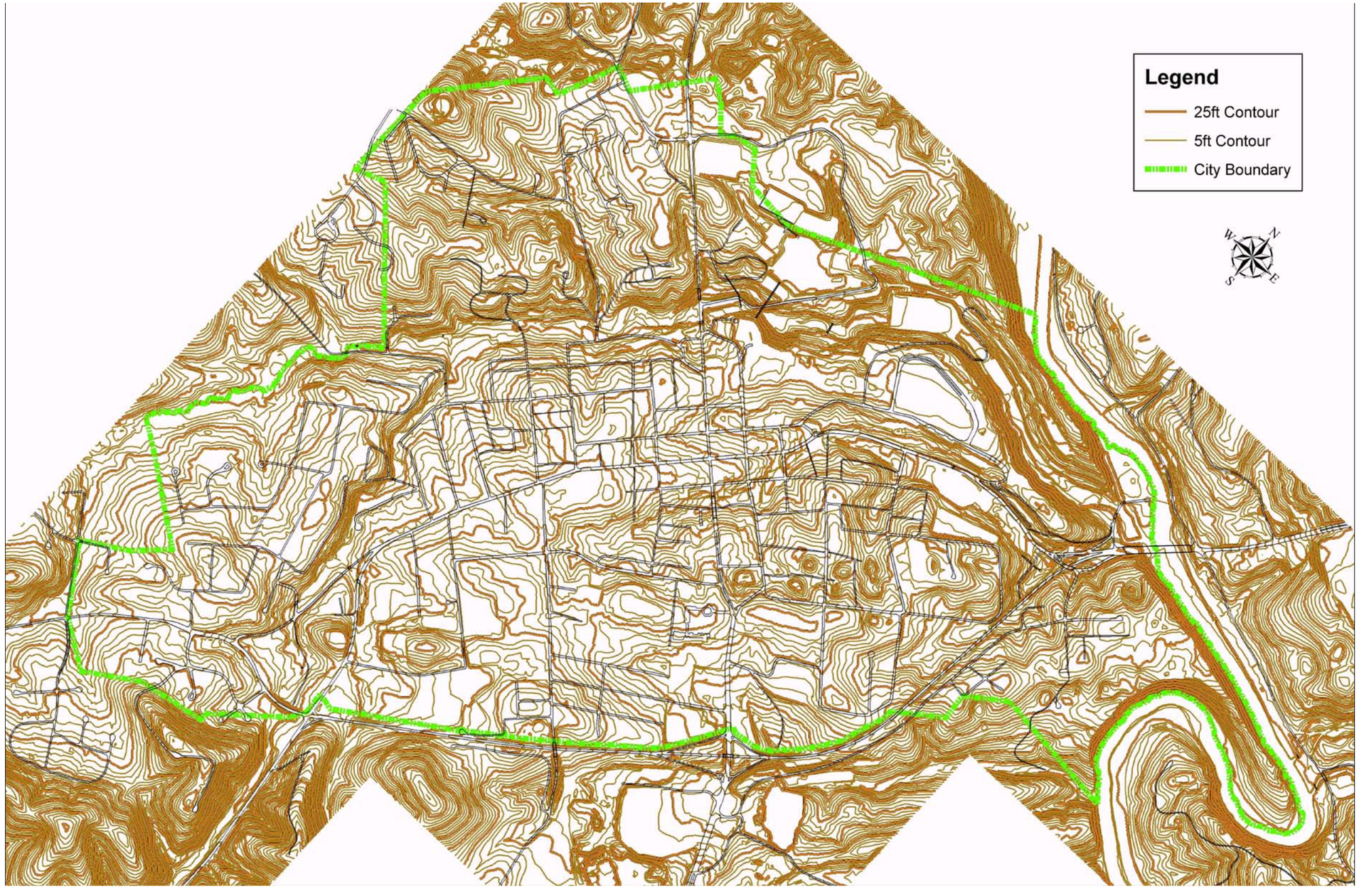
TOPOGRAPHY

The topography of the area is characterized by rolling hills and valleys, with the Allegheny Mountains (House Mountain, Hogback, Short Hill, North Mountain, Jump Mountain, etc.) to the west. Elevations in the City range from 890 feet along the Maury River to 1,185 feet on the western edge. The majority of the terrain in the City is rolling with moderate slopes. There are a few areas within the City limits with slopes exceeding 25 percent. These steep slopes are especially susceptible to erosion which creates natural constraints on their development. The engineering and construction requirements for providing sound, safe structures on these slopes further inhibits their development.

A map showing the topography of the greater Lexington area is provided as Figure 3.2.

OBJECTIVE: The City should use its development tools, such as site plan and subdivision review, to carefully monitor development on steep slopes to minimize soil erosion and the loss of significant natural environmental features

FIGURE 3.2
Topography of the Greater Lexington Area



SOILS AND SOIL SUITABILITY

The identification and location of various soil types determines what limitations or special capabilities each soil type has, and what the effects of development on a particular soil type might be. Soil type influences such things as drainage, erodibility, fertility, building foundation strength, and the suitability of septic tank wastewater disposal systems. All of these are important when considering the nature and extent of development that should occur within an area.

Valley carbonate soils dominate in the Lexington area. These are calcareous soils derived from limestone and dolomite which make up the major portion of the Great Valley. The most common soils found in the area are of the Chilhowie-Frederick Series and the Frederick-Hagerstown Series. These soils range from moderately deep to deep and are generally well drained. Topsoils are commonly silt loams and silty clay loams, while subsoils are mostly clays and silty clay loams. These soils are rated as moderate regarding significant building restrictions based on features such as low strength, high shrink-swell potential for heavy clay soils, severe slope and shallow depth to rock. The City Building Code requires that soil tests be conducted and footers be designed by a licensed professional if there is any concern about the bearing capacity of the soils at a building site.

The potential for soil erosion exists whenever land is disturbed for development, usually by grading. Exposure of bare soils to hard rains dramatically increases the amount of erosion and sedimentation which may occur. Lexington, with its characteristic sloping terrain, is faced with potential soil erosion problems whenever development occurs. The principal mechanism for addressing this concern is the City's Erosion and Sediment Control regulations, which require that a plan be prepared for all construction specifying how erosion will be minimized and how sediment will be controlled on the site. A performance bond must be posted for all construction, except single-family homes, to ensure that the measures indicated on the plan are properly installed and maintained. The City's Subdivision Regulations and site plan review process are secondary mechanisms to address this problem.

Figure 3.3 is a map showing the soil types in the greater Lexington area.

GOAL: Collaborate with Rockbridge County to assure that local erosion and sediment ordinances are uniform, regularly upgraded to reflect the latest standards and ~~aggressively~~ enforced within the Woods Creek watershed and other local watersheds.

OBJECTIVE: The City should continue to utilize and aggressively enforce regulations designed to minimize soil erosion and control storm water runoff.

FIGURE 3.3
Map of Local Soils

Legend

4 **Alonemill Fine Sandy Loam**
Slopes: 0% to 3%, occasionally flooded

9 **Pits, Quarries**

20C **Chilhowie - Rock Outcrop Complex**
Slopes: 2% to 15%

20E **Chilhowie - Rock Outcrop Complex**
Slopes: 15% to 60%

21B **Frederick Silt Loam**
Slopes: 2% to 7%

21C **Frederick Silt Loam**
Slopes: 7% to 15%

21D **Frederick Silt Loam**
Slopes: 15% to 25%

23C **Hagerstown Silt Loam**
Slopes: 2% to 15%,
very rocky

24C **Hagerstown - Rock Outcrop Complex**
Slopes: 2% to 15%,
very rocky

51A **Alonemill - Clubcaf Complex**
Slopes: 0% to 3%,
frequently flooded

61C **Chilhowie Silty Clay Loam**
Slopes: 7% to 15%

61D **Chilhowie Silty Clay Loam**
Slopes: 15% to 25%

Note: Only those soils and slopes within and immediate to the City of Lexington are included on this Legend

SOURCE: United States Department of Agriculture, NRCS

MINERAL RESOURCES

Mineral resources are limited in the Lexington area. In the late 1800s and early 1900s, a number of minerals were mined in the area. These included iron ore, manganese ore, tin ore, and sandstone. The only significant mining done today is that of limestone and shale quarrying.

WATER RESOURCES

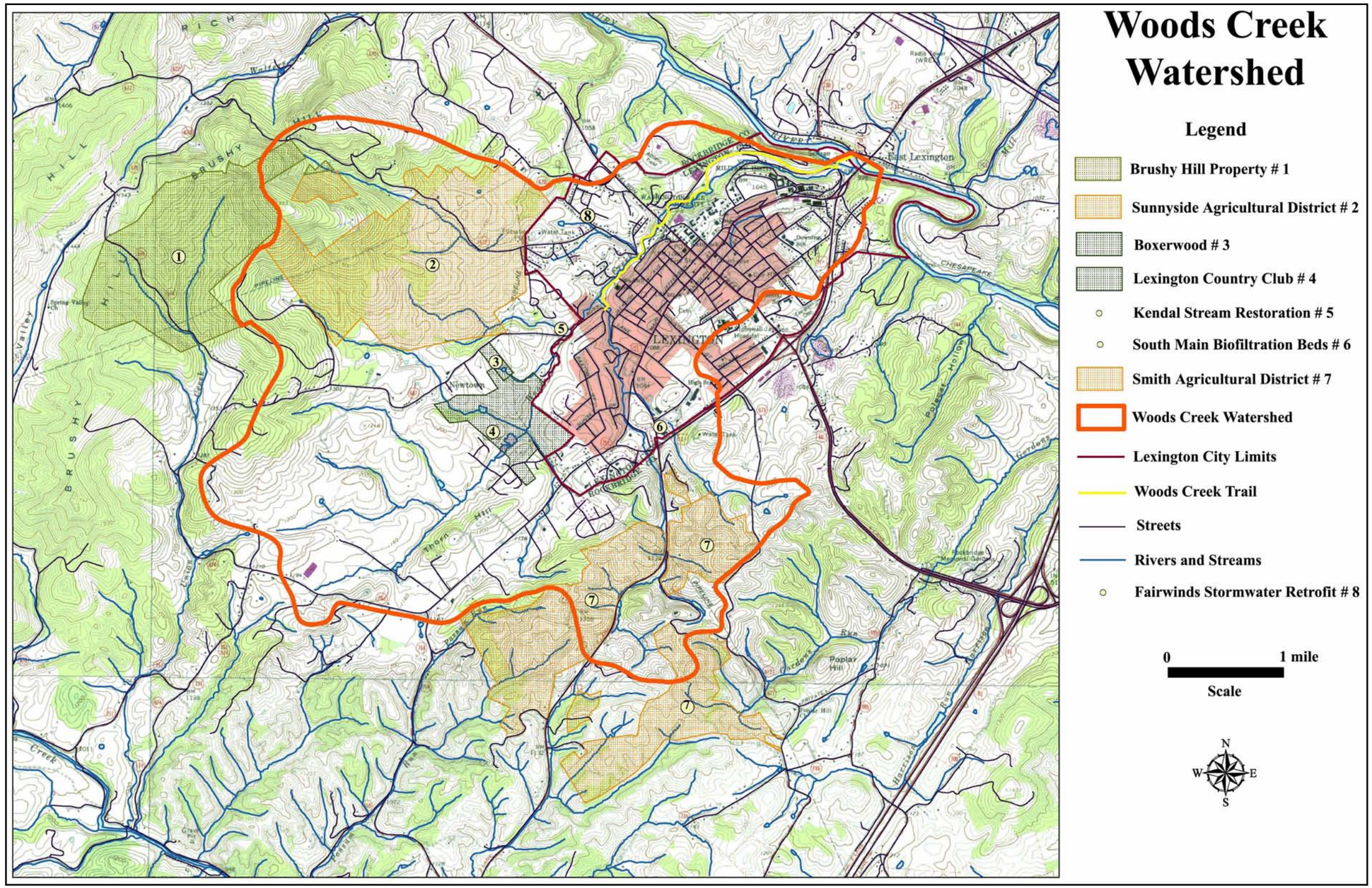
Most of the City is drained by Woods Creek and its tributaries including Sarah's Run, Spring Branch, and Town Branch. Woods Creek joins the Maury River at Jordan's Point.

The McCorkle Watershed receives surface water from a small area in the southeast corner of the City, including the East Nelson Street commercial corridor, Central Elementary School, and Evergreen Cemetery. This water flows out of the City to the southeast into an unnamed creek which parallels McCorkle Drive as it flows to the Maury River.

Because all the surface water in the City eventually flows into the Maury River, Lexington is part of the Maury River drainage area or watershed which drains 103,450 acres. Because the Maury feeds into the James River which, in turn, feeds into the Chesapeake Bay, all of the City of Lexington and Rockbridge County are within the James River and Chesapeake Bay watersheds.

The Woods Creek Watershed drains a 5.2 square mile area that includes parts of Rockbridge County and much of the City of Lexington. Its headwaters span from the Brushy Hills to the hills comprising Jacob's Ladder to the east of Route 11 South. Creeks and other water resources within the Woods Creek Watershed include Sarah's Run, Spring Branch, Town Branch and several small, unnamed spring branches and intermittent streams. Land use in the upper reaches is primarily woodland and agricultural fields. The Lexington Country Club golf course and its surrounding suburban residential development are in this watershed.

FIGURE 3.4
Woods Creek Watershed



Water Quality

Water quality and stream health in Woods Creek have declined significantly in recent decades. These water quality problems are closely associated with the uses being made of the land in the watershed.

The agricultural areas in the upper reaches of the watershed are mostly used for hay and for grazing cattle. When livestock are permitted to graze right to the stream banks, they destroy the buffer of native trees, shrubs and herbaceous plants which protect the streambank and filter out pollutants from surface runoff entering the stream. When they enter the stream to drink, their waste contributes fecal coliform bacteria and unwanted nutrients to the water. Livestock and farm equipment also compact the soils reducing their permeability. Fertilizers and herbicides used on agricultural fields can also be washed into nearby streams. The Natural Bridge Soil and Water Conservation District and the Virginia Cooperative Extension Service both, work with farmers to implement programs to address these problems.

In the more urban parts of the watershed, especially where Woods Creek and Sarah's Run flow through Lexington, other problems arise. As forests and farmlands have been converted to residential and commercial use, there are significant increases in the volume, rate and frequency of stormwater runoff. Much of the ground in these areas is covered by impermeable surfaces like roads, rooftops, and parking lots. Runoff is increasingly converted from sheet flow across the ground into ditches and pipes which focuses the runoff into limited areas. In areas where the native streambank vegetation has been removed, this leads to increased downstream flooding and erosion along the banks of creeks which are carrying higher water volumes.

This runoff contains pollutants such as petroleum hydrocarbons, heavy metals, and chlorides from the streets, pesticides, herbicides, nitrogen, and phosphorous from residential back yards, and sediment from construction sites. All of these pollutants have adverse effects on the health of Woods Creek. Nitrogen and phosphorous from fertilizers feed algal blooms, depriving fish and other aquatic organisms of dissolved oxygen. Sediment can clog streams, stagnating flow and reducing water quality. Hydrocarbons from gasoline and oil, chlorides from road salt, herbicides, pesticides, and heavy metals such as lead are poisonous to aquatic life, and do not simply "go away" when water flows out of Woods Creek, but persist and can cause problems for years. The temperature of runoff from impermeable surfaces and an absence of trees and shrubs shading the creek leads to an increase in the temperature of the water which also contributes to a decline in stream health.

Since 2003, local citizen volunteers involved with the Virginia Save our Streams program have been conducting periodic water quality testing at two sites in Woods Creek located within the City to evaluate its ecological health. Their testing protocol involves sampling benthic macroinvertebrates, organisms which live in and on the streambed. By determining the types and numbers of these macroinvertebrates, it is possible to indirectly estimate stream health since different species will predominate depending on water quality. Recent results of this testing are reported in Table 3.1 and represented graphically in Chart 3.1.

TABLE 3.1
Maury Watershed Monitors
Water Monitoring Scores as of 1/07*

Woods Creek Water Monitoring Scores													
Site 11: above the confluence of Sarah's run													
Test Date	1/5/02	9/9/03	3/18/04	6/13/04	1/2/05	4/9/05	7/23/05	9/18/05	12/31/05	3/11/06	4/1/06	7/25/06	10/14/06
Score	11	9	6	11	9	11	12	11	11	6	8	9	10
Site 12: adjacent to the Route 60 bridge													
Test Date	9/9/03	12/29/03	3/24/04	6/28/04	10/1/04	12/18/04	3/26/05	9/24/05	12/30/05	6/6/06	7/2/06	9/30/06	1/14/07
Score	6	10	10	10	9	4	11	6	6	7	8		4

Ecological Score:
Acceptable: 9-12
Marginal: 8
Unacceptable: 0-7

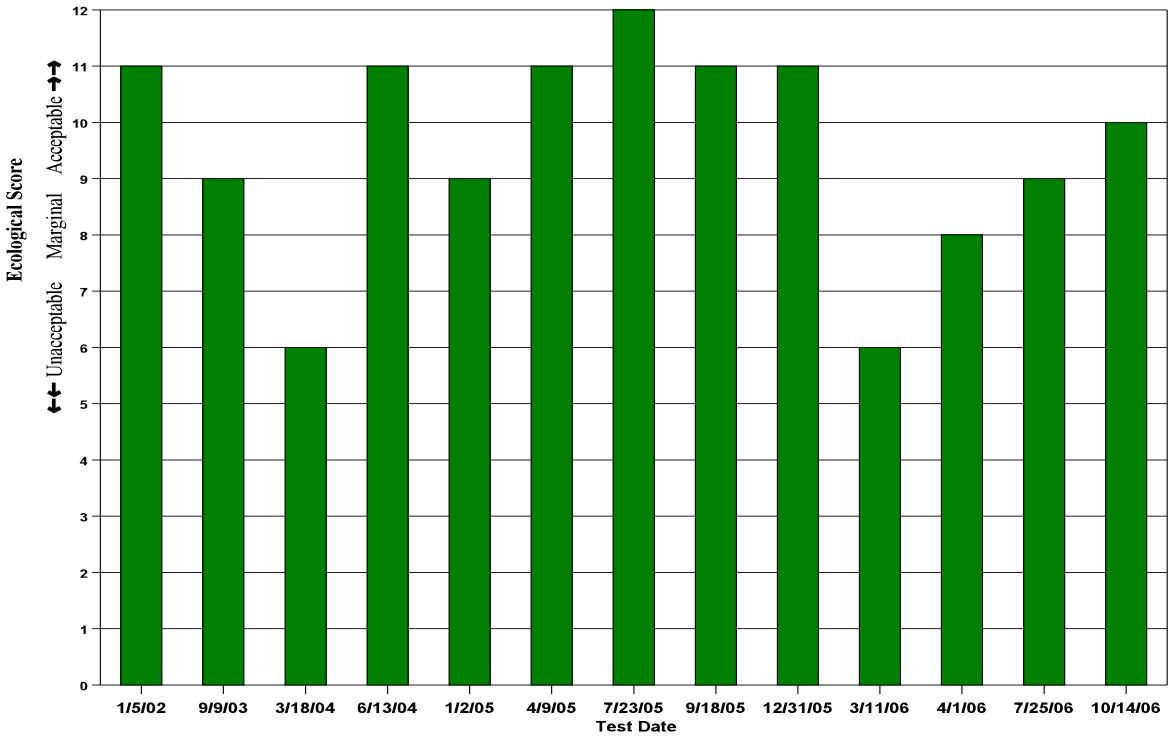
Fish Kills in Woods Creek**:
June, 1998
April, 2003
July, 2006

Proposed Site 13 (Department of Environmental Quality): **Test Date - 4/30/05** **Ecological Score - 6**
under bridge at Jordan's Point Park, before Woods Creek enters the Maury River

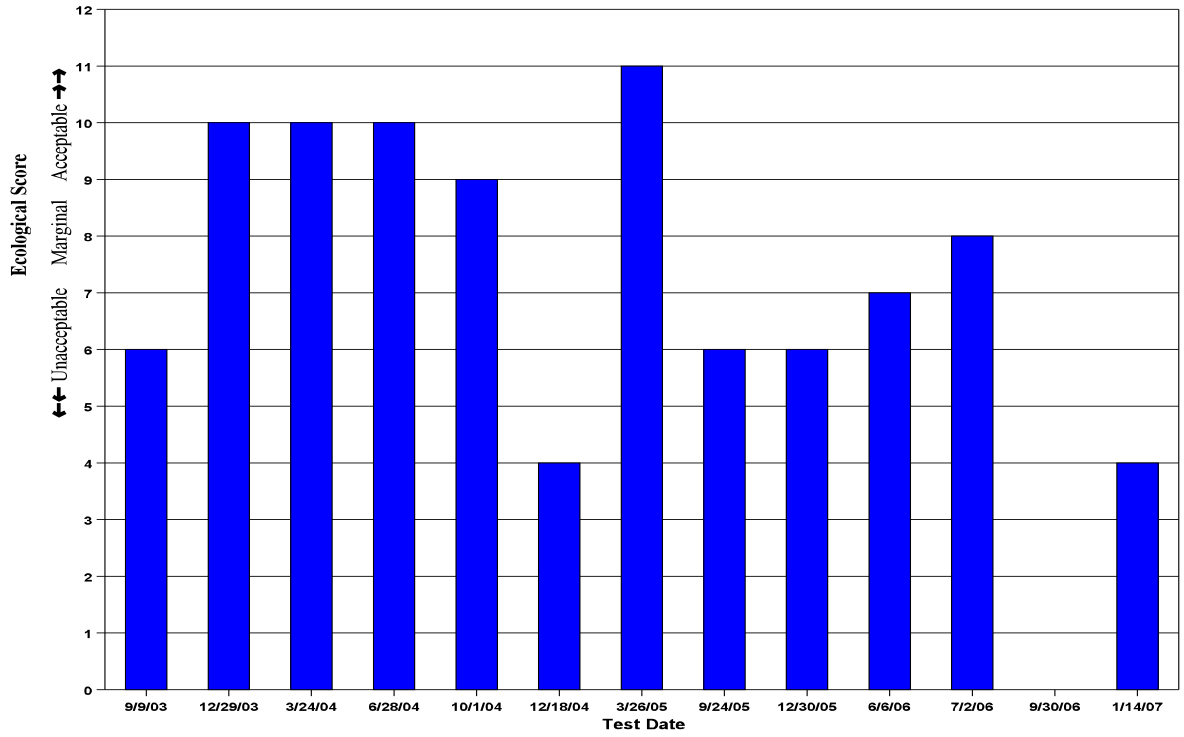
*Source: VASOS webpage: www.vasos.org
**Reported to DEQ

CHART 3.1
Water Monitoring Scores

Woods Creek Site 11: above confluence with Sarah's Run



Woods Creek Site 12: adjacent to Route 60 bridge



The Woods Creek 11 site is located on Woods Creek immediately above its' confluence with Sarah's Run; Woods Creek 12 is located adjacent to the Route 60 bridge just above the Washington and Lee campus. An "acceptable ecological" score is between 9 and 12, an 8 is described as a "gray zone", and a score of 0 to 7 is an "unacceptable ecological score". As the data demonstrates, the biological health of these portions of Woods Creek clearly continues to decline. Scores have been in the "unacceptable" range for the last two years, with the most recent test reporting a 4, well into the unacceptable range.

A succinct summary of the problem was provided by a biologist with the Virginia Department of Environmental Quality who was asked to comment on the recent macroinvertebrate sampling result:

> An urban stream will remain impaired as long as high volumes of stormwater are delivered by pipes directly to the stream from impervious surfaces. Our cities were designed (and continue to be designed) to move water safely away from people, not to deliver it in an environmentally sound way to our streams. Without a chance to enter the ground, water will reach the stream with excess velocity and without any natural filtration through the soil. This is a double-whammy on the streams biota, and only the most tolerant will survive in that environment. In my opinion, without tackling this problem, you will not see long-term improvement in Woods Creek's benthic community.

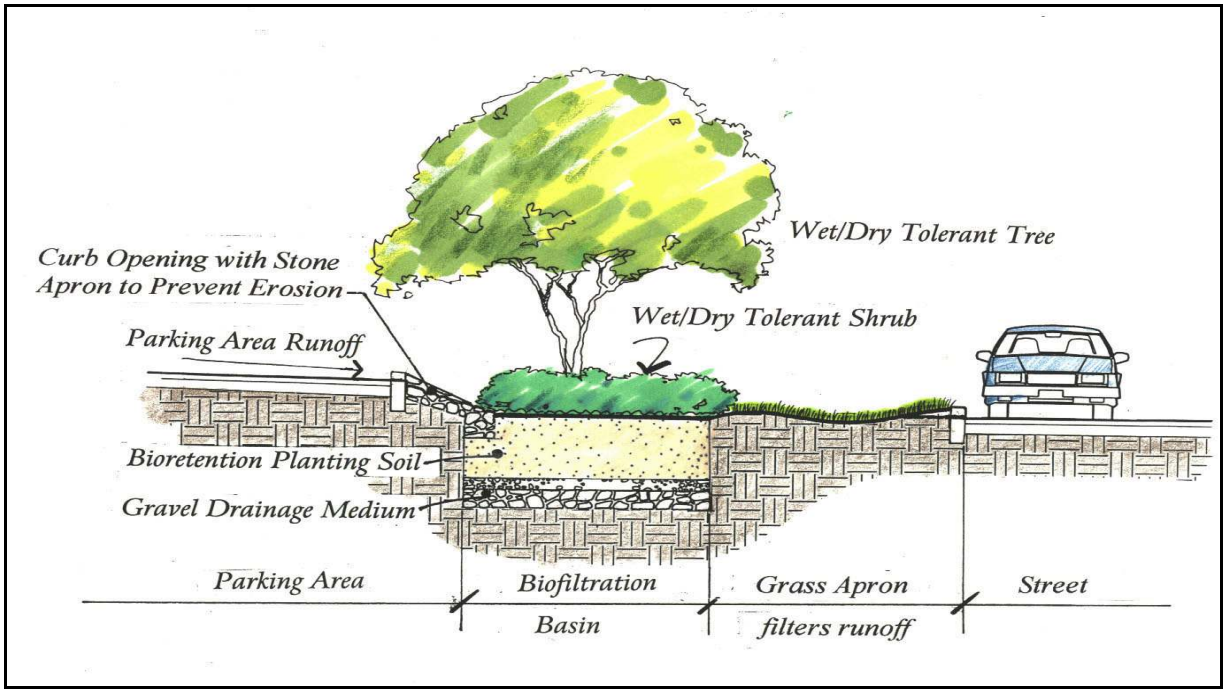
Recognizing that the long term health of Woods Creek, a critical local natural resource, was seriously threatened, the City of Lexington, in cooperation with Rockbridge County, developed a strategy to preserve and enhance the health of Woods Creek and its watershed, which it has been working to implement since 2001.

The first component of this strategy is to reestablish the "riparian buffer", a permanent area of trees, shrubs and other vegetation, along the banks of Woods Creek and its tributaries, to reduce the impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients and other chemicals contained in water runoff. Adequate buffers are estimated to be nearly 70 to almost 100 percent effective at filtering nutrients and sediment from runoff. Riparian buffers also moderate runoff and protect the stream bank. In the parts of the watershed where agriculture is the main land use, these buffers should be supplemented by measures to protect the streams from livestock by fencing and providing alternative water sources. Buffers have been reestablished along most of the publicly owned portions of Woods Creek, most planted by community volunteers. Because not everyone is comfortable walking in such natural areas manicured access pathways through the buffer must also be established and maintained.

OBJECTIVE: The City should create and maintain a number of groomed access points through the riparian buffer to Woods Creek between Ross Road and Lime Kiln Road to provide enhanced access to the creek.

In the urbanized portion of the watershed the use of "bioretention and biofiltration" facilities or "rain gardens" is being encouraged. These are man-made depressions in the ground used for landscaping as well as to improve water quality and are suitable for residential, commercial and industrial land uses. They collect water runoff from surrounding impervious surfaces, such as roofs and paved areas, and store it, permitting it to be filtered and slowly absorbed by the soil. Their purpose is to reduce the volume and increase the quality of water entering conventional storm drains and nearby streams. The City of Lexington has taken the lead in promoting and constructing rain gardens. Five have been constructed along South Main Street as part of the City's urban beautification project. Others have been constructed at Kendal and at the entrance to Fairwinds, where a stormwater management pond was modified to incorporate biofiltration and bioretention. Washington and Lee University has also installed several on their campus. The parking lots being constructed by Virginia Military Institute also incorporate bioretention and biofiltration.

FIGURE 3.5
Rain Garden



The City and Boxerwood Educational Association have prepared a "how-to" manual for homeowners to enable them to incorporate small rain gardens into their landscape. Collectively, numerous individual rain gardens would provide substantial neighborhood and community-wide environmental benefits.

The City is also working to make homeowners aware of practices which contribute to polluted runoff including the improper use and disposal of house and yard chemicals and excessive use of fertilizers and pesticides.

The City and the Boxerwood Educational Association annually sponsor **Woods Creek Restoration Day** in late April. The focus of this day is to train and assist community volunteers in the planting and care of a renewed riparian buffer along the banks of Woods Creek. Education concerning problems and opportunities in the watershed is a second focus. Over 150 people have participated in this event each year.

The City is revising its development regulations to require biofiltration and bioretention as part of the stormwater management strategy for future construction projects.

The City has also prepared a brochure containing a map of the watershed, describing its problems as well as the strategies and projects undertaken by the City and its partners to address these problems.

OBJECTIVE: The City should continue its efforts to address the declining water quality in Woods Creek and its watershed including restoration of the riparian buffer along streams, installation of bioretention and biofiltration facilities for new and existing development, and community education and involvement.

OBJECTIVE: Support efforts to improve the Woods Creek water quality monitoring system to document changes in water quality and flow to better assess the effectiveness of mitigation measures, provide adequate warning of any increases in impairment and provide an accurate basis for identifying specific sources of excessive runoff and pollutants.

Storm Water Runoff and Storm Water Management

As has been previously described, increased urbanization leads to a significant increase in the amount of impervious surfaces, which leads directly to increases in the volume, velocity and rate of surface water runoff during and after significant rainfalls. These changes lead to increased stream bank erosion in downstream channels, as well as a significant increase in pollutants contained in that runoff. The increased volume of runoff, as well as the increased rate of that runoff, leads to increased streambank erosion and high peak flows and decreased groundwater recharge.

State and City regulations require that the problems associated with stormwater runoff be addressed when development occurs. Developers of property are required to control rainfall runoff in order to protect downstream property, ensure that downstream storm drains and channels can adequately handle the volume of runoff, and preserve natural creek channels.

The Commonwealth of Virginia has established minimum standards for stormwater management. State law permits localities to adopt more stringent standards. The State regulations address only the quantity and rate of stormwater which may be discharged from a site. Again, the regulations also allow localities to adopt regulations which require that water quality also be addressed.

The stormwater management regulations for the City should be updated to require that water quality measures be incorporated for stormwater management plans for all new development. Because much of the development within the watershed is taking place in the headwaters in Rockbridge County, the County should also be encouraged to adopt these regulations.

OBJECTIVE: Update the City's stormwater management regulations to require that water quality measures be addressed for all significant new development and encourage Rockbridge County to adopt these regulations for the entire Woods Creek Watershed.

OBJECTIVE: Consider the creation and implementation of a City best practices integrated pest management program to minimize use of toxic chemicals including pesticides, herbicides, fertilizer, cleaning products, road salt and other pollutants.

OBJECTIVE: Continue to collaborate with Rockbridge County to implement water quality improvement goals throughout the Woods Creek Watershed.

OBJECTIVE: Work with Rockbridge County to designate the Woods Creek Watershed as one of special concern, subject to specific ordinances tailored to address water quality improvement concerns.

Inflow and Infiltration

Inflow and infiltration are terms used to describe the ways that surface water makes its way into sanitary sewer pipes.

Inflow is stormwater that enters sanitary sewer pipes through direct connections. These are primarily sump pumps, downspouts from roof gutters and foundation drains. This water should be allowed to soak into the ground (possibly by using a rain garden) rather than being directed into the sewer system. These improper connections can contribute significant amounts of water to sewer systems. (An 8 inch sewer line can carry the waste from up to 200 homes, but the downspouts from 6 homes can overload the capacity of that same pipe).

Infiltration is groundwater that enters sanitary sewer systems through leaks or cracks in the sewer pipes or manholes. These problems may be caused by deterioration, loose joints, root infiltration or other damage. Because sewer pipes are routed along creeks, they are especially susceptible to infiltration when flooding covers pipes and manholes with water.

Wet weather increases inflow and infiltration and can fill sewer pipes to capacity. If sewer lines become overloaded, manholes can pop open releasing wastewater onto the ground and into streams. These overflows release potential pathogens, such as fecal coliform, into streams.

The City's sewer system experiences major inflow and infiltration problems during hard rains, especially when the rain is accompanied by flooding. There are major sewer lines along both

Woods Creek and Sarah's Run. Manholes along both of these creeks have overflowed with wastewater during periods of high water. These releases may further impair streams, as well as impact the health of residents and wildlife.

The City has a major ongoing program to seek out and correct inflow and infiltration problems. Significant resources are invested each year to correct any problems which are discovered. Much of the system is over 25 years old and continued deterioration of the pipes in the system will occur. As a result, the City expects that continued detection and correction of inflow and infiltration into the system will be required.

OBJECTIVE: The City should aggressively continue its program to identify and correct sources of inflow, leaks and infiltration into its sanitary sewer system.

OBJECTIVE: The City of Lexington should support efforts to prevent pollutants from being disposed of into storm drains which empty into local creeks and then into the Maury River.

FLOODWAYS

The Maury River and its tributary streams in the Lexington area are subject to flooding during times of heavy rains or quick thaws. Figure 3.6 delineates the estimated, historical 100 year floodplain within the area. This estimate is based on limited data under historical conditions and does not indicate what the 100 year flood plain will be under changing conditions such as increased development within the watershed or climate change.

The City's Zoning Ordinance regulates development within the floodplain. These regulations prohibit most development and activities from locating in areas subject to flooding and requires that those uses, activities and developments which may locate in flood prone areas be protected against flooding and flood damage.

OBJECTIVE: The City should continue to aggressively enforce local regulations designed to regulate development within the floodplain

OBJECTIVE: Consider updating current stormwater management regulations, in concert with Rockbridge County, to limit the expansion of the 100-year flood plain resulting from continuing development and increasing storm water runoff.

FIGURE 3.6
The 100 Year Floodplain
City of Lexington

SINKHOLES

Lexington is part of a large karst region characterized by caves, sinkholes, sinking creeks, and large springs. Over millions of years, water working down through the underlaying limestone and dolomite dissolves the rock and creates passageways and caves. When a cavern becomes large enough, its roof cannot provide enough support and a cave-in results, creating the steep walled, closed depressions on the ground surface known as sinkholes. When a sinkhole is formed, surface runoff is channeled into it and joins the groundwater. There are several known sinkholes in the City.

There are three potential problems associated with development in karst regions: subsidence, sinkhole flooding, and water pollution. First, these regions present the potential hazard of surface subsidence or collapse. To reduce the risk of collapse or subsidence, development on existing sinkholes should be avoided and test borings should be made before any development is undertaken in areas where sinkholes are thought to exist.

Sinkhole flooding has two possible causes: the plugging of natural sinkhole drains by sediment and the overwhelming of natural sinkhole drains by increases in runoff caused by artificial surfaces. The plugging of the drains is often the result of insufficient erosion control during construction. The increased runoff which causes flooding is generally due to the presence of roads, parking lots, and structures. Much of the precipitation which would have percolated through a vegetated soil cover is introduced rapidly into surface and subsurface drainage networks (through sinkholes) and exceeds the capacity of the natural drain, thereby resulting in overflows. There are no known instances of sinkhole flooding in the City.

Another possible problem associated with development in karst regions is the potential for pollution of groundwater because rain which falls into areas drained by sinkholes is channeled directly into the subterranean aquifer.

CLIMATE

Lexington enjoys a moderate climate with cold, but not extreme, winters and generally warm summers. Daytime temperatures during the summer average in the 70s , with nighttime lows averaging in the 50° F range. The annual mean temperature averages about 56° F. Extremes of 102° F and -8° F have been recorded.

The growing season, defined as the period between the average date of the last freezing temperature in spring (April 26), and the average date of the first freezing temperature in the fall (October 11), is 168 days. However, freezing temperatures have occurred as late as May 28 and as early as September 21.

The annual precipitation averages 38 inches. Monthly mean rainfall is generally two to three inches during the winter months and three to four inches during the summer months. The average snow accumulation is approximately 22 inches per year. Prevailing winds in the area are primarily from the southwest but, during the cold months, winds frequently come from the northwest.

AIR QUALITY

The quality of the air is a significant factor in determining the quality of life of an area. People who have the choice generally prefer not to live in areas in which there are significant pollutants in the air. Because quality of life is important both to citizens presently living here and as a fundamental component of the City's economic development strategy, the City should actively involve itself in decisions and measures affecting local air quality.

In the Great Valley of Virginia, which includes Rockbridge County and Lexington, two factors - weak winds and thermal inversions - sometimes combine and create stagnant air conditions. These stagnant air periods generally last four or five days before being cleared out by a storm system. Although this has proven to be a problem in other areas in the United States, there is currently no significant problem with air pollution locally during these stagnant air periods, as defined by the National Ambient Air Quality Standards.

The National Clean Air Act of 1970 and its subsequent amendments required the Environmental Protection Agency (EPA) to establish ambient ceilings for six significant air pollutants. At high levels, these pollutants can injure humans by causing respiratory and cardiovascular problems, harm the environment by impairing visibility, and by causing damage to animals, vegetation and buildings. The EPA has established regulations setting permissible levels of these pollutants in the air.

These national standards have been adopted by the Virginia State Air Pollution Control Board as air quality standards for the State. Virginia has also been required to identify areas of the State which meet and do not meet the National Ambient Air Quality Standards. While there

are areas in the region that have designated as non-attainment areas according the the Virginia Department of Environmental Quality, Lexington and Rockbridge County are not among them.

The Environmental Protection Agency has promulgated standards which limit the increases above established baseline levels for certain pollutants. These allowable increases are called Prevention of Significant Deterioration (PSD) increments. The regulations require that the total increases in ambient concentrations from all PSD permitted sources must not exceed these PSD increments. Depending on the anticipated level of emissions, any proposed activity which has the potential to increase any of the air pollutants regulated under the Clean Air Act may be asked by the Department of Environmental Quality to prove by statistical and computer modeling techniques that it will not cause the area in which it proposes to locate to exceed any of the established standards. This analysis must address the existing ambient air quality, potential impacts from the proposed source and potential cumulative impacts from other sources of air pollution near the site.

As a result, Rockbridge County and the City must be concerned about the development of new industries locating anywhere in the Shenandoah or New River Valleys if they release significant amounts of air pollutants and, as a result, utilize a significant portion of the remaining PSD increments. This concern is necessary because the development of air polluting industries elsewhere could preclude the development of industries in the local area which would only make a minor contribution to air pollution if there are no remaining PSD increments. Because of the regional nature of air quality, the City by itself, can do little to change these patterns; however, the City can actively participate in processes and programs aimed at limiting and controlling air polluting activities.

The City of Lexington is in an area identified as having a high probability of the presence of radon. Radon is a colorless, odorless, tasteless, chemically inert, radioactive gas. Naturally occurring, low levels of uranium occur widely in the earth's crust. The Surgeon General of the United States has issued a health advisory about the health risk from exposure to radon from indoor air, since more than 20,000 Americans die from radon-related cancer each year. The International Building Code, which the State of Virginia has adopted as its building code, specifies control measures for new construction to reduce radon entry and means which can be undertaken in existing buildings to reduce the presence and entry of radon. There are test kits available to test homes to find out if radon is present.

OBJECTIVE: Protect local air quality by participating in Federal, State and regional initiatives to control air pollutants and improve air quality

One of the principal sources of pollutants in the City is automobiles. Efforts to promote more efficient traffic movement will help restrict air pollution.

OBJECTIVE: Implement transportation strategies which help enhance local air quality.

THE URBAN FOREST AND CITY GREENSPACES

The extent, character and health of a city's trees, shrubs and open spaces are keys to the environmental health of a community. The urban forest includes trees and associated plants. Lexington also has areas of unforested green spaces notably in parks and recreation areas. Together these two areas comprise a green infrastructure, a network that sustains clean air and water, cools summer "heat islands", and enriches the quality of life for residents. Greener communities are measurably better in the quality of their air, water, energy and public health.

ICMA, the International City/County Management Association, recommends that communities do the following to establish and maintain a healthy urban forest: create a data layer devoted to trees in the city's geographic information system and create a formal process for tracking tree cover; adopt public policies, regulations, and incentives to increase and protect the urban forest; and establish a tree canopy goal to be considered as part of every development project.

American Forests, a national organization that works to protect, restore and enhance the natural capital of trees and forests, recommends the following generic tree canopy guidelines for specific zoning categories:

- Suburban residential zones 50 percent
- Urban residential zones 25 percent
- Business districts 15 percent

The current tree inventory only measures trees on public property, a small percentage of the city's total urban tree cover. The City is currently applying for a grant to assess canopy coverage through the City Arborist's Office. A product of that grant will be a map describing not only the urban tree canopy, but also the extent of the city's green infrastructure.

The City has taken a number of steps to protect and expand its urban forest. The Lexington Tree Committee was created in 1996 as a committee of the Historic Lexington Foundation to promote the planting of trees in the City with their focus on the downtown and the commercial entrance corridors. The committee actively looked for possible sites for trees and raised funds for their planting. Over 300 trees were planted as a result of their efforts. They also championed the creation of the City's first Tree Ordinance which was adopted in 2000 and revised in 2005.

Among the purposes of the Tree Ordinances are the following:

- Establish and maintain the maximum sustainable amount of tree cover on public and private lands in the City;
- Maintain City trees in a healthy and non-hazardous condition through good arboricultural practices;
- Promote conservation of tree resources;

- Foster community awareness and support for a local urban forestry program and foster good tree management on privately owned properties.

The Tree Ordinance also mandated the creation of a City Tree Board and the hiring of a City Arborist.

The responsibilities of the City Arborist include:

- Developing a comprehensive Tree Management Plan which governs tree planting, maintenance and removal of trees planted along City streets and in public areas, and making provisions for educating the public about trees.
- Directing municipal tree-care operations
- Conducting community outreach and education programs
- Providing advice to City residents concerning the care and maintenance of privately owned trees.

In addition to the Arborist, the City of Lexington employs a part-time, seasonal gardener, who is an employee of the Department of Public Works. This employee is responsible for the upkeep of plant beds throughout the city, including the rain gardens.

The Tree Board has the following responsibilities:

- Reviewing and approving requests for planting or removing trees within the Central Business District;
- Conducting community outreach and education programs
- Assisting with the development, revision and evaluation of the Comprehensive Tree Management Plan;

A tree inventory of close to 900 public trees was completed in 2002 and will be updated in 2007. These trees have been added as a separate layer on the City's computerized mapping system. A comprehensive Tree Management Plan was created in 2003 and will be updated in 2008. This plan governs tree planting, maintenance, and removal of trees planted along City streets and in public areas, and makes provisions for educating the public about trees.

The City's site plan review regulations, which require that a site plan be reviewed and approved by the Planning Commission for all new construction and additions to existing structures for all buildings except one- and two-family residences, include a requirement for a landscape plan. The Entrance Corridor Overlay Districts, which incorporate the East Nelson Street and South Main Street commercial corridors, also require that a landscape plan be approved. The City's Subdivision Regulations require that street trees be included in all residential subdivisions. The City Tree Ordinance protects trees planted in subdivisions or as part of a site plan. All of these tools provide the City with the ability to require that trees be planted as part of private development projects.

Since 2000, Lexington has been recognized annually as a Tree City, USA by the National Arbor Day Foundation.

OBJECTIVE: Protect existing tree stands and encourage additional planting of trees, not only along streets but throughout the community.

Trees improve air quality by cleansing the air of pollutant gases and particles and by storing carbon; therefore, implementing this objective will also serve to enhance local air quality.

PRESERVATION OF IMPORTANT NATURAL FEATURES

The natural features which have been identified and described in this Chapter play a major role in determining the quality of life for local residents. It is important that the City take action when necessary to ensure that significant natural features be preserved and protected.

The City's site plan review requirements, planned unit development provisions and conditional use process provide the tools to review development plans and ensure that important natural resources are identified and preserved. The floodplain regulations are another tool. Conditional rezoning can also be utilized to protect key features. Planned unit development can be used to encourage buildings, roads and utilities to be laid out in ways which preserve significant natural features.

OBJECTIVE: Utilize the City's development regulations to require that new development identifies, preserves and protects important natural features.

Stream valleys are usually unsuited for development because of their flooding potential. These areas are attractive natural areas well suited for active and passive recreational activities. Woods Creek Park and the trails through the W&L campus and VMI Post, with the connection to the Chessie trail, are excellent examples of this strategy. The City should strive for a continuous and interconnected system of public open space within the City with connections to other existing systems. An interconnected system of open space is more usable than distinct, unconnected pockets of open space.

The City of Lexington has taken a leadership role in promoting public awareness of environmental health and sustainability issues through the sponsorship of workshops and environmental education programs for all ages, such as established by partnering with Boxerwood, by developing and distributing leaflets, pamphlets and a rain garden manual, and the installation of educational signage at water quality improvement sites.

OBJECTIVE: Protect and enhance the City's open space system.

OBJECTIVE: Consider more extensive use of conservation tools such as riparian easements and conservation easements to permanently protect important local natural features

FUTURE PLANNING FOR A GREEN INFRASTRUCTURE

Natural resource planning has traditionally focused on protecting important individual natural features. A new approach, called "green infrastructure" planning has been evolving in recent years. Green infrastructure is defined as a network of open spaces, woodlands, stream corridors, wildlife habitat, parks and other natural areas that sustain clean air, water quality and natural resources which enrich the quality of life for communities and their residents. The concept of green infrastructure also repositions open space protection from a community amenity to a community necessity since it emphasizes the idea that the elements of a green infrastructure network need to be protected over the long term to sustain local environmental health and quality of life.

An important concept in green infrastructure is the importance of linking these green spaces to preserve and connect natural areas to benefit biodiversity, counter habitat fragmentation and connect parks and other green spaces for the benefit of people. Green infrastructure planning also encourages more walkable communities by seeking ways to connect its components.

Green infrastructure planning differs from conventional approaches to open space planning because it looks at conservation values and actions in concert with land development, growth management and planning for the built infrastructure. As a result, it offers an innovative tool to land conservation challenges since it seeks to plan land development and land conservation together in a way that is consistent with natural environmental patterns. Green infrastructure planning provides a framework for development as well as helping to restore and protect naturally functioning ecosystems.

Green infrastructure planning should be integrated into this chapter when it is updated. Developing a participatory community process to identify our green infrastructure and create such a plan is possible and has merit since it will allow those living and working here to identify the components which are important to them. The Rockbridge Area Conservation Council (RACC) has pledged its participation in the planning process leading up to the adoption of a green infrastructure plan. RACC, Boxerwood and other local organizations could partner with the City to create a process designed to bring together organizations, individuals, and agencies to identify the components of our local green infrastructure

GOAL: Encourage local environmental and community groups to work together, with the assistance of City staff, to engage the community in a planning process to create a green infrastructure plan.

GOALS AND OBJECTIVES

The following goals and objectives are contained in the Natural Features chapter:

GOAL: Maintain the quality of life by preserving the natural environment and protecting against environmental hazards

GOAL: Continue to work to be a good steward of our natural resources and a good neighbor to other communities whose environment, including their watersheds, air quality, and view sheds may be impacted by our activities.

OBJECTIVE: The City should use its development tools, such as site plan and subdivision review, to carefully monitor development on steep slopes to minimize soil erosion and the loss of significant natural environmental features

GOAL: Collaborate with Rockbridge County to assure that local erosion and sediment ordinances are uniform, regularly upgraded to reflect the latest standards and enforced within the Woods Creek watershed and other local watersheds.

OBJECTIVE: The City should continue to utilize and aggressively enforce regulations designed to minimize soil erosion and control storm water runoff

GOAL: The City should create and maintain a number of groomed access points through the riparian buffer to Woods Creek between Ross Road and Lime Kiln Road to provide enhanced access to the creek.

OBJECTIVE: The City should continue its efforts to address the declining water quality in Woods Creek and its watershed including restoration of the riparian buffer along streams, installation of bioretention and biofiltration facilities for new and existing development, and community education and involvement.

OBJECTIVE: Support efforts to improve the Woods Creek water quality monitoring system to document changes in water quality and flow to better assess the effectiveness of mitigation measures, provide adequate warning of any increases in impairment and provide an accurate basis for identifying specific sources of excessive runoff and pollutants.

OBJECTIVE: Update the City's stormwater management regulations to require that water quality measures be addressed for all significant new development and encourage Rockbridge County to adopt these regulations for the entire Woods Creek watershed.

OBJECTIVE: Consider the creation and implementation of a City best practices integrated pest management program to minimize use of toxic chemicals including pesticides, herbicides, fertilizer, cleaning products, road salt and other pollutants.

OBJECTIVE: Continue to collaborate with Rockbridge County to implement water quality improvement goals throughout the Woods Creek Watershed.

OBJECTIVE: Work with Rockbridge County to designate the Woods Creek Watershed as one of special concern, subject to specific ordinances tailored to address water quality improvement concerns.

OBJECTIVE: The City should aggressively continue its program to identify and correct sources of inflow, leaks and infiltration into its sanitary sewer system.

OBJECTIVE: The City of Lexington should support efforts to prevent pollutants from being disposed of into storm drains which empty into local creeks and then into the Maury River.

OBJECTIVE: The City should continue to aggressively enforce local regulations designed to regulate development within the floodplain.

OBJECTIVE: Consider updating current stormwater management regulations, in concert with Rockbridge County, to limit the expansion of the 100-year flood plain resulting from continuing development and increasing storm water runoff.

OBJECTIVE: Protect local air quality by participating in Federal, State and regional initiatives to control air pollutants and improve air quality

OBJECTIVE: Implement transportation strategies which help enhance local air quality

OBJECTIVE: Protect existing tree stands and encourage additional planting of trees, not only along streets but throughout the community

OBJECTIVE: Utilize the City's development regulations to require that new development identifies, preserves and protects important natural features.

OBJECTIVE: Protect and enhance the City's open space system.

OBJECTIVE: Consider more extensive use of conservation tools such as riparian easements and conservation easements to permanently protect important local natural features

GOAL: Encourage local environmental and community groups to work together, with the assistance of City staff, to engage the community in a planning process to create a green infrastructure plan.